

**PREPARATION OF LOW MOLECULAR WEIGHT NATURAL RUBBER  
VIA PHOTOOXIDATION IN LATEX STATE**

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**PREPARATION OF LOW MOLECULAR WEIGHT NATURAL RUBBER  
VIA PHOTOOXIDATION IN LATEX STATE**

**by**

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requirement for the Doctor of Philosophy**

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## LIST OF ABBREVIATIONS

AOP	Advanced oxidation process
$^{13}\text{C}$	Carbon thirteen NMR
$\text{CDCl}_3$	Deuterated chloroform
$\text{C}_q$	Quaternary carbon
DEPT	Distortionless enhancement by polarization transfer
DPNR	Deproteinized natural rubber
DRC	Dry rubber content
ENR	Epoxidized natural rubber
ENR50	Epoxidized natural rubber with 50% mole epoxidation
EVA	Ethylene vinyl acetate
FE-SEM	Field emission scanning electron microscopy
FTIR	Fourier transform infrared
GPC	Gel permeation chromatography
$^1\text{H}$	Proton NMR
$\text{H}_2\text{O}_2$	Hydrogen peroxide
HA	High ammonia natural rubber latex
HMQC	Heteronuclear multiple quantum coherence
HTNR	Hydroxyl telechelic liquid natural rubber
ICP-MS	Inductively coupled plasma mass spectrometry
IRCA	<i>Institute de Recherches sur la Caoutchouc</i>
$\text{K}_2\text{S}_2\text{O}_8$	Potassium persulfate
LATZ	Low ammonia-tetramethyl thiuram disulphide/zinc oxide preserved NR latex

LENR	Liquid epoxidized natural rubber
LNR	Liquid natural rubber
MB	Methylene blue
Mn	Number average of molecular weight
NMR	Nuclear magnetic resonance
NR	Natural rubber
OH	Hydroxyl
PE	Polyethylene
RAFT	Reversible addition-fragmentation chain transfer
SDS	Sodium dodecyl sulfate
TEM	Transmission electron microscopy
Teric	Teric 16A30
TGA	Thermogravimetric Analysis
TiO <sub>2</sub>	Titanium dioxide
TMS	Tetramethylsilane
TMTD	Tetramethylthiuram disulfide
TPNR	Thermoplastic natural rubber
TTIP	Titanium tetrakisoperoxide
UV	Ultraviolet
XRD	X-ray diffraction spectroscopy

## LIST OF SYMBOLS

°	Degree
°C	Degree celcius
$\alpha$	Alpha
$\beta$	Betha
$\mu\text{m}$	Micronmeter
$\theta$	Theta
$\omega$	Gamma
Phr	Part per hundred rubber
%	Percentage
Mn	Number average molecular weight
$\delta$	Delta
nm	Nanometer
g/mol	Gram per mole

# **PENYEDIAAN GETAH ASLI RENDAH BERAT MOLEKUL MELALUI FOTOOKSIDASI DALAM KEADAAN LATEKS**

## **ABSTRAK**

Cahaya ultraungu (UV) telah digunakan untuk mengurai bahan organik, termasuklah getah asli (GA) terutama dalam pelarut organik. Kajian ini bertujuan untuk menyediakan getah asli cecair (GAC) menggunakan kaedah fotodegradasi di dalam lateks, dan mencirikan sifat fizikal dan kimia GAC yang diperolehi. Kecekapan tindakbalas telah ditentukan melalui pengurangan berat molekul dan kandungan gel. Struktur molekul GAC ditentukan melalui inframerah transformasi fourier (FTIR) dan resonans magnet nuklear (NMR). Sementara itu, mikroskop elektron imbasan (SEM) dan mikroskop elektron penghantaran (TEM) telah digunakan untuk mengenalpasti morfologi partikel lateks. Parameter tindakbalas seperti cahaya UV, suhu, hidrogen peroksida, masa tindak balas, kandungan getah kering (DRC) dan penstabil telah menunjukkan kesan bersinergi dan mempengaruhi keberkesanan tindakbalas. Surfaktan jenis anionik (SDS) didapati memberikan kestabilan yang lebih baik kepada lateks GA berbanding dengan surfaktan bukan ionik (Teric). Keupayaan zeta bagi lateks GA telah meningkat semasa tindakbalas photodegradasi, disumbangkan oleh caj negatif asid lemak. Kandungan fosfat yang mewakili asid lemak didapati meningkat dalam serum lateks, terhasil daripada penguraian fosfolipid apabila terdedah kepada UV dan agen pengoksidaan. Titanium dioksida ( $\text{TiO}_2$ ) anatase telah disediakan melalui kaedah gel sol. Penyebaran  $\text{TiO}_2$  kedalam lateks telah menunjukkan kesan pemangkinan terhadap fotodegradasi. Kehadiran metilen biru sebagai fotosensitif telah menurunkan sedikit berat molekul GAC. Pemutusan rantai GA semasa fotodegradasi berlaku pada ikatan  $\text{C}=\text{C}$  dan  $\text{C}-\text{C}$ . Struktur molekul GAC

adalah hampir sama dengan GA, tetapi terdapat peningkatan kumpulan hidroksil dan karbonil. Kumpulan-kumpulan fungsi ini terbentuk hasil dari pemutusan rantai GA. Tindakbalas fotodegradasi terhadap lateks getah asli terepoksida (ENR50) telah menunjukkan reaksi tindakbalas yang sama dengan lateks GA tanpa menjejaskan peratusan mol epoksi. Walau bagaimanapun, kehadiran  $\text{TiO}_2$  tidak mempengaruhi tindakbalas, tetapi telah menyebabkan pembukaan gelang kumpulan epoksi kepada hidroksil.